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[Title of the Invention] METHOD AND APPARATUS FOR RECEIVING DIGITAL SIGNALS

[Scope of Claim for a Patent]

[Claim 1]

A method of receiving a digital signal for a system in which:

a plurality of bit-compressed channel programs and their guide information are received;

a program is selected from the plurality of received programs;

the selected program is recorded and reproduced with a recording/reproducing apparatus; and

the reproduced program is bit-expanded to restore and display an original program,

said method comprising:

selecting the guide information of the selected program from the received plurality of guide information sets and generating new guide information;

outputting the selected program and the new guide information to the recording/reproducing apparatus at the same time; and

bit-expanding and restoring the reproduced program in accordance with the new guide information reproduced with the recording/reproducing apparatus.

[Claim 2]

A method according to claim 1, wherein:

at least two programs among the plurality of programs and the plurality of guide information sets are time-division multiplexed, packeted, and transmitted;

said guide information contains at least identification information of each packet;

the identification of each packet is read from the reproduced new guide information; and

a packet of the reproduced program is selected and bit-expanded in accordance with the read packet information.

[Claim 3]

A method according to claim 1, wherein:

a current time is set by using date and time information contained in the guide information of the plurality of received programs;

said new guide information includes the date and time information contained in the guide information of the plurality of received programs;

the current time is compared with the date and time information contained in the reproduced new guide information; and

bit expansion of the reproduced program is inhibited if the comparison result indicates a lapse of a predetermined time period.

[Claim 4]

In a system in which:

a plurality of bit-compressed channel programs and their guide information including at least information of a date and time of program reception are transmitted and received;

a program is selected from the plurality of received programs;

the selected program is recorded and reproduced with a recording/reproducing apparatus; and

the reproduced program is bit-expanded to restore and display an original program,

said system comprises:

means for producing new guide information by selecting guide information and information of date and time of the selected program from the plurality of received programs;

means for outputting the selected program and the new guide information to the recording/reproducing apparatus at the same time;

means for setting a current time by using information of date and time contained in the guide information of the plurality of received programs;

means for comparing the current time with the information of the time and data contained in the reproduced new guide information; and

means for inhibiting bit expansion of the

reproduced program if the comparison result indicates that a predetermined period has lapsed.

[Detailed Description of the Invention]

[0001]

[Industrial Field of Utilization]

The present invention relates to a method and apparatus for receiving, recording, and reproducing digital signals of movies, programs, and the like transmitted via transmission media such as coaxial cables, telephone lines, and broadcast satellites. More particularly, the invention relates to such a method and apparatus capable of constraining a reproduction of a recorded digital signal.

[0002]

[Prior Art]

A method of inhibiting a copy of a video signal with a recording/reproducing apparatus is disclosed, for example, in Japanese Patent Laid-open Publication No. 61-288582 (hereinafter called a first Publication). The technique described in this first Publication adds a signal immediately after a synchronization signal of a video signal so that although a television can display this video signal, a video tape recorder (VTR) can record only an image of poor quality.

[0003]

Another Japanese Patent Laid-open Publication No. 4-360068 (hereinafter called a second Publication)

discloses techniques of restricting a user to copy data or inhibiting a user to see an image of data, with a data recording/reproducing apparatus.

[0004]

As a method of compressing digital video signals at a high efficiency, the ITU-T Draft Rec. H. 262 standard called MPEG-2 (Moving Picture Experts Group) is known. MPEG-2 Systems Working Draft is also known which is the transmission standard of video and audio signals compressed by MPEG-2.

[0005]

[Problems that the Invention is to Solve]

The above standards show the techniques of compressing a program and broadcasting it in a digital format. This compression method realizes a large compression rate so that a single transmission channel can broadcast programs four to eight times as many as a conventional analog broadcast. With this technique, services called near video-on-demand are already available in which the same 2-hour movie is repetitively broadcast at an interval of 30 minutes. However, it is impossible to broadcast all programs 24 hours a day for near video-on-demand. Therefore, subscribers have a great need for recording a program and reproducing it at a desired time to watch it.

[0006]

In recording/reproducing a digitally compressed

and broadcast program, it can be considered that a received digital signal is expanded and converted into an analog signal to record it with a conventional analog VTR. However, an analog signal recorded in the analog VTR loses a good S/N ratio of digital signals.

[0007]

Although it is desired to directly record a digital broadcast signal itself, the technique of recording digital signals compressed and transmitted in conformity with the MPEG standard is not disclosed as yet. Generally, error correction is performed to a sufficient degree during recording/reproducing digital signals so that it is advantageous in that the same tape can be repetitively viewed without any image quality degradation. However, on the other hand, if the same tape is allowed to be repetitively viewed without any image quality degradation, a video tape like a cell video tape (a commercial video cassette tape of movies or the like) can be formed easily so that protection of the rights of a copyright holder is difficult. The above cited first Publication discloses the technique of protecting the rights of a copyright holder for conventional analog VTRs. The second Publication discloses the technique of restricting a user to copy data or inhibiting a user to see an image of data, with a data recording/reproducing apparatus.

[0008]

However, techniques of recording digital signals

compressed and transmitted in conformity with the MPEG standard and restricting copies of recorded digital signals are not shown at all.

[0009]

It is another object of the present invention to provide a method and apparatus for efficiently recording a signal compressed and broadcast, for example, in conformity with the MPEG standard, and constraining reproduction of such signals.

[0010]

[Means for Solving the Problems]

In order to solve the above problems, the following means are provided. Specifically, in a system in which a plurality of bit-compressed channel programs and their guide information including at least information of a date and time of program reception are transmitted and received, a program is selected from the plurality of received programs, the selected program is recorded and reproduced with a recording/reproducing apparatus, and the reproduced program is bit-expanded to restore and display an original program, the system comprises: means for forming new guide information by selecting guide information and information of date and time of the selected program from the plurality of received programs; means for outputting the selected program and the new guide information to the recording/reproducing apparatus at the same time; means for setting a current time by using

information of date and time contained in the guide information of the plurality of received programs; means for comparing the current time with the information of the time and data contained in the reproduced new guide information; and means for inhibiting bit expansion of the reproduced program if the comparison result indicates that a predetermined period has lapsed.

[0011]

[Operation]

The current time can be correctly and reliably set from the guide information of the plurality of received programs. Since the current time is set from the received information, it cannot be changed by a subscriber. Furthermore, new guide information is formed from received guide information when the selected program is recorded, and the new guide information contains information of date and time of program reception. Therefore, a lapse time from the program reception can be known correctly and reliably by comparing the program reception date and time with the current date and time. If the lapse time exceeds the predetermined time, bit expansion is inhibited to restrict reproduction of a recorded tape.

[0012]

[Embodiments]

A video distribution service using a satellite according to an embodiment of the invention will be described with reference to Fig. 1. In Fig. 1, a reference

numeral 10 designates a software supplier, numeral 20 an operation center, numeral 30 a program distribution center, numeral 31 a transmitter, numeral 35 a current broadcasting station, numeral 36 a transmitter, numeral 40 an artificial satellite for distributing signals, numeral 50 a subscriber household, numeral 51 a receiver, numeral 52 a receiver decoder, numeral 53 a VTR, numeral 54 a TV receiver, numeral 55 a telephone set, and numeral 56 a receiver.

[0013]

The video distribution service is carried out by an operator managing the operation center 20. The operator signs a contract with the software supplier 10 and causes the required software to be supplied from the software supplier 10 to the program distribution center 30. According to the embodiment shown in Fig. 1, only one supplier 10 is shown. Normally, however, a plurality of software suppliers are engaged in supplying software.

[0014]

The program distribution center 30 transmits a radio wave toward the satellite 40 by means of the transmitter 31 installed in the center 30. The satellite 40 receives the radio wave and retransmits it toward the subscriber 50. The radio wave thus transmitted is received by the receiver 51. According to the embodiment shown in Fig. 1, only one subscriber 50 is shown. Actually, however, a plurality of subscribers exist.

[0015]

The radio wave received by the receiver 51 is applied to the receiver decoder 52, and the software of a predetermined channel is selected by the receiver decoder 52. The software thus selected is recorded in the VTR 53 as required. The signal recorded in the VTR 53 and reproduced at the desired time is returned to the receiver decoder 52, restored into the original video signal, and applied to the TV receiver 54. In the case where the subscriber desires to watch the program without recording, the original video signal is restored without the VTR 53 and applied to the TV receiver 54.

[0016]

The subscriber may request a desired software from the operation center 20 by way of the telephone 55. Also, the operation center 20 can survey the receiving and viewing conditions of the subscriber 50 through the telephone channel from the receiver decoder 52 and charge the subscriber 30 in accordance with the viewing conditions.

[0017]

Further, the radio wave transmitted from the current broadcast station 35 by the transmitter 36 is received by the receiver 56 and the received signal is input and recorded in the VTR 53. The signal reproduced in the VTR 53 may be applied to the TV receiver 54 to view the program. In the case where the VTR 53 is not required to

record the program, the signal from the receiver 56 is of course applied to the TV receiver 54 and the program can be viewed directly.

[0018]

Fig. 2 is a block diagram showing the program distribution center 30 according to an embodiment in detail. In Fig. 2, numeral 100 designates input means for software sent from the software supplier 10, numeral 101 input means for a control signal for the program or the like sent from the operation center 20, numeral 115 a supply unit for a storage medium, numerals 160 to 163 storage media, numerals 170 to 173 bit compressors, numeral 180 a transmission processing device, numeral 190 a program controller, and numeral 191 a program guide generator.

[0019]

The embodiment shown in Fig. 2 represents the case in which software is sent from the software supplier 10 in a storage medium. In this case, the terminal 100 acts only as a window for receiving the storage medium by the program distribution center 30. The storage medium thus received is stored in a storage medium supply unit 115 on the one hand and is supplied to the storage media 160 to 163 under the control of the program controller 190. The signals reproduced at the storage media 160 to 163 are applied respectively to the bit compressors 170 to 173, where they are bit-compressed according to the MPEG-2 standard or the like. The output signal of the compressors

170 to 173 is applied to the transmission processing device 180.

[0020]

Also, a control signal for the program issued or the like is applied from the operation center 20 through the input means 101 to the program controller 190. The program issue control signal from the program controller 190 is applied to the storage medium supply unit 115, the storage media 160 to 163 and the transmission processing device 140. In accordance with this control signal, as described above, the storage medium in the storage medium supply unit 115 is supplied to the storage media 160 to 163 thereby to control the reproduction, termination, etc. of the software of the storage media 160 to 163.

[0021]

Further, the guide information for the program distributed to the subscriber 50 from the program distribution center 30 is generated in the program guide generator 191 in accordance with the information from the program controller 190, and applied to the transmission processing device 180. The transmission processing device 180 processes signals for transmission in accordance with, for example, the MPEG transmission standard described above. The signal thus processed for transmission is applied to the transmitter 31 and transmitted toward the satellite 40 from the transmitter 31.

[0022]

Fig. 3 is a block diagram showing an example of the signal processing operation in the transmission processing device 180. In Fig. 3, numerals 170a to 173a, 190a, 191a designate input terminals, numerals 170b to 173b, 31a output terminals, numerals 181 to 184 encryptors, numeral 185 a time-division multiplexer, numeral 186 an error correction code adder, and numeral 187 a modulator.

[0023]

In Fig. 3, the signals from the bit compressors 170 to 173 are applied through the input terminals 170a to 173a to the encryptors 181 to 184, respectively. The encryptors 181 to 184 encrypt the supplied programs as required. This encryption may be effected only on the video signal or the audio signal, or on both the video signal and the audio signal. The signal thus encrypted is applied to a time-division multiplexer 185. The terminal 190a is an input terminal for the signals from the program controller 190. The viewing right control signal for each program is applied through the terminal 190a to the time-division multiplexer 185. This signal includes a signal indicating whether a particular subscriber has the viewing right for the signal broadcast. Further, the time-division multiplexer 185 is supplied with program guide information from a program guide generator 191. Each signal is packeted in a predetermined format and compressed and multiplexed temporally. According to this embodiment, the

viewing right control signal and the program guide information are shown without an encryptor. These signals, however, may also be encrypted.

[0024]

The rate control information for each program is applied through the terminal 190a. This is the information for bit-compressing the program input from the bit compressor 170 in the range of 4 to 8 Mbps, and the program input from the bit compressor 171 in the range of 2 to 6 Mbps, for example. According to this information, the time-division multiplexer 185 controls the bit rate of the bit compressors 170 to 173. The time-division multiplexer 185 applies a control signal to the bit compressors 170 to 173 through the output terminals 170b to 173b. As a result, the bit rate of each program is controlled in such a way that the signal rate after time-division multiplexing is less than a predetermined value.

[0025]

The output signal of the time-division multiplexer 185 is applied to the error correction code adder 186. In the case under consideration, an error correction code is added for correcting the transmission error caused by the noise in a satellite channel shown, a CATV channel, or the like. The output signal of the error correction coder is applied to the modulator 187, and in the case of the embodiment shown in Fig. 3, the programs of four channels are modulated on a single carrier thereby

constituting a single transmission channel. The signal modulated on the single carrier is sent toward the transmitter 31 through the terminal 31a.

[0026]

Although the embodiment shown in Fig. 2 has four storage media so that the transmission processing device 180 can be supplied with four programs, more programs can be time-division multiplexed by use of more storage media.

[0027]

According to the embodiment shown in Fig. 2, signals for a single transmission channel are processed. Instead, signals for a plurality of transmission channels can be sent by providing a plurality of combinations of the storage media 160 to 163, the bit compressors 170 to 173 and the transmission processing device 180.

[0028]

The transmission channel is defined as a signal modulated on a single carrier by time-division multiplexing a plurality of programs as described above. Each of a plurality of programs is referred to simply as a channel.

[0029]

Fig. 4 shows a specific example of the configuration of a receiver decoder at the subscriber household 50. In Fig. 4, numeral 200 designates an input terminal for a signal from the receiver 51, numeral 201 an input-output terminal for a signal for requesting a software from the operation center or a signal for

exchanging the signal for determining the receiving conditions of a fee-charging broadcast, numeral 202 an output terminal for a signal restored, numeral 203 an input-output terminal for a signal exchanged with the VTR, numeral 205 an input terminal for a signal from the receiver 56 shown in Fig. 1, numeral 210 a tuner, numeral 220 an error correction circuit, 230 a program dividing circuit, numeral 240 a change-over circuit, numeral 250 a decryption circuit, numeral 260 a decoding circuit for bit expansion, numeral 270 a signal output processing circuit, numeral 280 a control circuit, and numeral 290 an interface circuit.

[0030]

The receiver 51 that has received a signal from the satellite 40 applies the received signal to the tuner 210 through the terminal 200. The tuner 210 selects from among the received signals the signal of a desired transmission channel in accordance with the control signal from the control circuit 280, and demodulates the signal modulated by the modulator 187 and applies the demodulated signal to the error correction circuit 220. The error correction circuit 220 corrects any error occurred mainly in the channel in accordance with the error correction code added by the error correction code adder 186. The signal the error of which has been corrected is applied to the program dividing circuit 230. The program dividing circuit 230 selects and outputs a desired program in accordance

with the control signal from the control circuit 280 from a plurality of programs time-division multiplexed by the time-division multiplexer 185 on a single transmission channel.

[0031]

The output signal of the program dividing circuit 230 is applied to the change-over circuit 240 and the interface circuit 290, and further through the output terminal 203 to the VTR 53. The VTR 53 records the digital bit stream applied thereto, and at playback, applies a signal to the interface circuit 290 through the terminal 203 in the same format as the input bit stream. The output signal of the interface circuit 290 is applied to the change-over circuit 240. The change-over circuit 240 selects and outputs a signal from the program dividing circuit 230 when restoring the received signal and selects and outputs a signal from the interface circuit 290 when selecting and outputting a reproduced output signal of the VTR 53, in accordance with the control signal from the control circuit 280.

[0032]

The output signal of the change-over circuit 240 is applied to the decryption circuit 250. The decryption circuit 250 decrypts the signal encrypted by the encryptors 181 to 184. The signal decoded from the code produced by the decryption circuit 250 is applied to the decoding circuit 260, where the bits compressed at the bit

compressors 160 to 163 shown in Fig. 2 are decoded and decompressed.

[0033]

The bit-decompressed signal from the decoding circuit 260 is applied to the output processing circuit 270 as a component signal containing a luminance signal and two color difference signals. The two color difference signals applied to the output processing circuit 270 are subjected to quadrature modulation and thus converted into a carrier chrominance signal, so that the output processing circuit 270 produces the resulting carrier chrominance signal and the luminance signal. The output signal is applied through the terminal 202 to the TV receiver 54. Just in case the TV receivers 54 has only a composite input terminal, the output processing circuit 270 may produce a composite signal by adding the luminance signal and the carrier chrominance signal. Further, both a signal containing the luminance signal and the carrier chrominance signal and a composite signal may be produced.

[0034]

Also, the signal applied from the receiver 56 through the input terminal 205 is recorded in the VTR 53 as required, and a reproduced signal, or if not recorded, an input signal or a signal equivalent to the input signal is applied to a TV image pick-up device 54. In the embodiment shown in Fig. 4, the signal not yet decrypted is recorded in the VTR 53, and therefore the signal is not necessarily

decrypted at the time of recording in the VTR 53. The subscriber thus can record free of charge and can be charged each time of playback.

[0035]

Fig. 5 shows another specific example of the receiver decoder shown in Fig. 1 according to an embodiment. The component parts included in Fig. 5, which are partially shared by the embodiment of Fig. 4, are designated by the same reference numerals as the corresponding parts respectively and will not be described in detail.

[0036]

According to the embodiment shown in Fig.5, the change-over circuit 240 is located behind the decryption circuit 250 as compared with the embodiment shown in Fig.4. Specifically, the output signal of the decryption circuit 250 is applied to the VTR 53 and the change-over circuit 240, and the output signal of the VTR 53 to the change-over circuit 240. The output signal of the change-over circuit 240 is applied to the decoding circuit 260.

[0037]

The embodiment shown in Fig. 5 concerns the case of recording a signal decrypted at the decryption circuit 250. In this case, the decrypted signal is recorded in the VTR 53. Therefore, the subscriber is charged for decryption at recording, and can playback without being charged.

[0038]

Although the decryption circuit 250 is arranged behind the program dividing circuit 230 in the embodiment shown in Fig. 5, the program dividing operation may be performed after decryption.

[0039]

Fig. 6 is a block diagram showing a VTR 53 according to an embodiment. In Fig. 6, numeral 300 designates an input-output terminal for a signal from the receiver decoder 52 shown in Fig. 1, numeral 302 an input terminal for a signal from the receiver 56 shown in Fig. 1, numeral 303 an output terminal thereof, numeral 305 an interface circuit, numeral 311 a parity adder circuit, numeral 312 a modulation circuit, numeral 320 a tape transport system, numeral 330 a demodulation circuit, numeral 331 an error correction circuit, numeral 340 an analog video signal recording circuit, numeral 350 an analog video signal reproduction circuit, numeral 360 an analog audio signal recording circuit, and numeral 370 an analog audio signal reproduction circuit.

[0040]

The signal applied through the input terminal 300 is applied to the parity adder circuit 311 through the interface circuit 305. The parity adder circuit 311 is for adding a parity code for correcting any error which may occur in the tape transport system 320. The output signal from the parity adder circuit 311 is applied to the

modulation circuit 312. The modulation circuit 312 modulates the digital signal into a form suitable for the tape transport system 320. Such schemes as NRZ, NRZI, 8-10 conversion, MFM, M2, etc. are known for modulation. The modulated signal is applied to the tape transport system 320 and recorded in the magnetic tape 1.

[0041]

At playback, the reproduced signal is applied to the demodulation circuit 330 where it is modulated in correspondence with the modulation circuit 312. The output signal of the demodulation circuit 330 is applied to the error correction circuit 331, where any error which may have occurred in the tape transport system 320 is corrected on the basis of the parity code added at the parity adder circuit 311. The output signal of the error correction circuit 331 is applied to the interface circuit 305, and after being converted into a signal in the same form as the signal input from the input terminal 300, is output from the terminal 300. The signal output from the terminal 300 is applied to the receiver decoder 52 shown in Fig. 1.

[0042]

As seen from the embodiment of Fig.6, the VTR 53 requires therein none of the bit compressors 170 to 173 shown in Fig.2, and therefore a digital signal VTR small in circuit size can be realized. Also, no bit compressor is required in each VTR, but only at the program distribution center 30. Therefore, although the circuit size and cost

are increased, a high-performance bit compressor can be used, and the resulting higher relative bit compression ratio reduces the data rate of the digital signal transmitted. Consequently, the VTR 53 used by the subscriber can be improved in quality, reduced in cost and can record for a longer time.

[0043]

An analog signal is applied through the terminal 302 from the receiver 56 to the analog video signal recording circuit 340 and the analog audio signal recording circuit 360, where the signal is processed according to the VHS standard, b standard or the 8-mm VTR standard, for example. The signal thus processed is applied to the tape transport system 320. The tape transport system 320 records the signal in accordance with respective formats as in the conventional VTR.

[0044]

At playback, the signal reproduced at the tape transport system 320 is applied to the analog video signal reproduction circuit 350 and the analog audio signal reproduction circuit 370 which process the reproduced signal in a manner corresponding to the analog video signal recording circuit 340 and the analog audio signal recording circuit 360, respectively. The reproduced signal is applied appropriately to the TV receiver 54 shown in Fig. 1 through the output terminal 303. As a result, the digital broadcast and the conventional analog broadcast can be

recorded using the same tape transport system.

[0045]

Fig. 7 is a model diagram showing an example signal (or an output signal from the output terminal 31a shown in Fig. 3) output from the transmitter 31. The embodiment of Fig. 7 shows the case in which four programs are transmitted through a single transmission channel according to the embodiment shown in Fig. 2. Also, the embodiment concerns the case in which there are a number n of transmission channels (1) to (n). In Fig. 7, V1, V2, V3 and V4 designate video signals of four programs, A1, A2, A3, A4 audio signals for four programs, PG a signal representing program guide information, and VECM, AECM a control signal representing the viewing rights. Each of these signals is a signal constituting a packet.

[0046]

In the embodiment shown in Fig.2, the four programs generally have different transmission rates. From the instantaneous point of view, the data amount is increased or decreased. In order to efficiently control this variation, each information is packeted and time-division multiplexed as shown in Fig. 7. Details of the signal in the packet are described in the transmission standards referred to above. Though not shown in detail in the model diagram of Fig. 7, the signal in each packet is encrypted by the encryptors 181 to 184 as required as explained with reference to Fig. 3. Also, the error

correction code adder 186 adds an error correction code and the time-division multiplexer 185 header information such as a synchronization signal.

[0047]

In the embodiments shown in Figs. 4 and 5, signals designated by (1) to (n) in Fig. 7 are supplied through the terminal 200, and a signal for one of the transmission channels is selected at the tuner 210. In the case under consideration, the signal of Fig. 7(1) is assumed to have been selected. The selected signal shown in Fig. 7(1) has an error thereof corrected at the error correction circuit 220 and is applied to the program dividing circuit 230. The program indicated by the suffix 1 is assumed to have been selected from the time-division multiplexed four programs at the program dividing circuit 230. In such a case, the program guide information PG, the viewing right control signals VECM, AECM are also separated and output at the same time as the video signal V1 and the audio signal A1. Fig. 8(2) shows the signal representing a divided program. Fig. 8(1) is identical to Fig. 7(1).

[0048]

With reference to the embodiments shown in Figs. 4 and 5, explanation will first be made about the case in which not the reproduced signal from the VTR 53 but the signal from the tuner 210 is selected directly by the change-over circuit 240. The signal divided into a program shown in Fig. 8(2) is decrypted by the decryption circuit

250. This decryption is performed according to the viewing right control signals VECM, AECM shown in Fig. 8(2). More specifically, in the case where a subscriber household has the right to view the program selected just now, the code is decrypted, while when the subscriber household has no right to view the program, the code is not decrypted. Instead, the absence of the viewing right is indicated or information indicating a method for acquiring the viewing right is output from the terminal 202. The output of this information is what is called an OSD. This information is added to the video signal and output from the output processing circuit 270.

[0049]

The signal decrypted is applied to the decoding circuit 260. The decoding circuit 260 corresponds to the bit compressors 170 to 173 shown in Fig. 2, and decodes a signal input according to the MPEG-2 standard. For example, the decoded signal is output via the output processing circuit 270 from the terminal 202.

[0050]

An output signal of the program dividing circuit 230 in the embodiment shown in Fig. 4 and an output signal of the decryption circuit in the embodiment shown in Fig. 5 are input via the terminal 203 to VTR 53. A signal shown in Fig. 8(2) is input to the interface circuit 290. A signal shown in Fig. 8(2) is recorded in VTR 53 in the manner described with the embodiment shown in Fig. 6.

[0051]

Next, the case where the change-over circuit 240 is connected to the reproduced signal from VTR 53 in the embodiments shown in Figs. 4 and 5 will be described. A signal is reproduced with VTR 53 in the manner described with the embodiment shown in Fig. 6, and input via the terminal 203 and interface circuit 290 to the circuit 240. This input signal is substantially the same signal input to the other terminal of the change-over circuit 240. Therefore, an output signal of the change-over circuit is supplied to the decryption circuit 250 of the embodiment shown in Fig. 4 or to the decoding circuit 260 of the embodiment shown in Fig. 5. In this manner, like the restoration of the signal received by the tuner 210, a signal from VTR 53 can be restored.

[0052]

Next, a method of restricting reproducing signals recorded with VTR 53 will be described. Table 1 shows example of the contents described in the program guide information PG shown in Figs. 7 and 8.

[0053]

[Table 1]

Table 1

CHANNEL	V PID	A PID	VE PID	AE PID	TITLE	START TIME	END TIME	DATE	TIME
100	V 100	A 100	VE 100	AE 100	NEWS	18:00	19:00	1995.1.1	18:05:30:00
100	V 100	A 100	VE 100	AE 100	NEWS	19:00	20:00		
100	V 100	A 100	VE 100	AE 100	NEWS	20:00	21:00		
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮		
101	V 101	A 101	VE 101	AE 101	BASE-BALL A-B	18:00	20:30		
101	V 101	A 101	VE 101	AE 101	BASE-BALL C-D	20:30	23:00		
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮		

[0054]

As shown in Table 1, the program guide information PG includes information V PID for identifying a packet of the video signal for each channel, information A PID for identifying a packet of the audio signal, information VE PID and AE PID for identifying a viewing right information packet, a program title, a program start time, a program end time, and the like. The program guide information PG also includes a date and time when the program guide information was received by the subscriber 50. As shown in Fig. 2, since a plurality of programs are multiplexed on one transmission channel, a program is required to be selected from a transmission channel selected by the tuner 210. In order to discriminate between the packets of the video signal, audio signal, program guide information, and viewing right information, different identification PIDs are added. Therefore, although different identification PIDs are required to be added to packets of the same transmission channel, the same packet identification information may be added to the packets of different transmission channels.

[0055]

The program guide packet PG is decoded by the decoding circuit 260 and output to the TV receiver 54 via the output processing circuit 270 and terminal 202 to select the channel of a program to be watched.

[0056]

If only one program is recorded with VTR 53 and it is to be reproduced, the program is desired to be directly reproduced without selecting the channel from the program guide information. To this end, the program guide packet itself is not recorded, but it is recorded after being changed in accordance with the program to be recorded. Fig. 8(3) shows an example of a recorded signal. The program information packet PG is changed, for example, by the interface circuit 290 so as to have the format limiting only to the channel information of the program to be recorded, as shown in Table 2. Fig. 8(3) shows this changed program information packet MPG.

[0057]

[Table 2]

Table 2

CHANNEL	V PID	A PID	VE PID	AE PID	TITLE	START TIME	END TIME	DATE	TIME
100	V 100	A 100	VE 100	AE 100	NEWS	18:00	19:00	1995.1.1	18:05:30:00

[0058]

Fig. 9 is a block diagram showing the details of the decryption circuit 250 and decoding circuit 260 shown in Fig. 4, according to another embodiment. In Fig. 9, reference numeral 400 represents an input terminal for a signal from the change-over circuit 240, reference numeral 401 represents an output terminal, reference numeral 404 represents an input/output terminal for a control signal to be transferred to and from the control circuit 280, reference numeral 405 represents an input terminal of a control signal from the control circuit 280, reference numeral 410 represents a selector, reference numeral 420 represents a program guide information read circuit, reference numeral 421 represents a program information decoding circuit, reference numeral 440 represents a viewing permission judging circuit, reference numerals 450 and 451 represent a decryption circuit, reference numeral 460 represents a video signal expansion circuit, reference numeral 461 represents an audio signal expansion circuit, and reference numeral 470 represents a selector.

[0059]

First, the case where a signal received by the tuner 210 is inputted, will be described. The signal corresponding to Fig. 8(2) is applied to the terminal 400. The program information packet PG has the same packet discrimination information for all transmission channels. Therefore, in accordance with this packet discrimination

information, the selector 410 selects the program guide information packet PG having the contents shown in Table 1. The program information read circuit 420 reads the program guide information and supplies it to the program guide decoding circuit 421 which in turn decodes it and supplies the results to the selector 470. A control signal from the control circuit 280 is applied to the terminal 404 and supplied to the program guide information read circuit 420 and selector 401. If the program guide information is selected, the selector 470 selects the signal input from the program guide decoding circuit 421 and outputs it from the terminal 401. This signal is then supplied via the output processing circuit 270 and terminal 202 to the TV receiver 54 to display the program guide.

[0060]

When a channel of a program is selected while looking at the displayed program guide information, the channel information is supplied via the terminal 404 from the control circuit 280 to the program guide read circuit 420 which reads the input packet discrimination information of the channel and supplies it to the selector 410. In accordance with the input packet discrimination information, the selector 410 supplies the video packet V1, audio packet A1, viewing right information packets VECM and AECM to the video expansion circuit 460, audio expansion circuit 461, and viewing permission judging circuit 440, respectively.

[0061]

The viewing permission judging circuit 440 transfers the control signal to and from the control circuit 280 via the terminal 405. In accordance with the input viewing right information packets VECM and AECM, the viewing permission judging circuit 440 judges whether the packets input to the decryption circuits 450 and 451 are to be decrypted. If the recorded program is to be charged, a control signal indicating a charged program is supplied to the control circuit 280 via the terminal 405. The control circuit 280 stores a charged toll of the program and supplies a viewing permission control signal to the viewing permission judging circuit 440 via the terminal 405. The viewing permission judging circuit 440 generates, if necessary, decryption information by using the viewing right information packets VECM and AECM, and supplies the packets to the decryption circuits 450 and 451. In accordance with signals input from the viewing permission judging circuit 440, the decryption circuits 450 and 451 decrypt the video packet V1 and audio packet A1. The decrypted video and audio packets V1 and A1 are supplied to the video expansion circuit 460 and audio expansion circuit 461.

[0062]

The bit compressed video and audio signals are expanded by the video and audio expansion circuits 460 and 461 and supplied to the selector 470. In accordance with

the control signal input from the terminal 404, the selector 470 outputs the expanded or decoded video and audio signals from the terminal 401.

[0063]

Next, the case where a signal reproduced by VTR 53 is inputted, will be described. In this case, a signal corresponding to Fig. 8(3) is inputted from the terminal 400. Since the changed program information packet MPG has the same packet discrimination information as the program guide information packet before the change, this packet MPG is supplied via the selector 410 to the program guide read circuit 420. If a signal for selecting the program guide information is supplied via the terminal 404, the same process as when the signal is inputted from the tuner 210 is performed to display on the TV receiver 54 the program information reproduced by VTR 53 and having the contents shown in Table 2.

[0064]

If the signal for selecting the program guide information is not supplied via the terminal 404, the program guide read circuit 420 supplies the selector 410 with the packet discrimination information of the video and audio packets V1 and A1 and viewing right information packets VECM and AECM of the program reproduced. These packets are then supplied to the decryption circuits 450 and 451 and viewing permission judging circuit 440. As shown in Table 2, since the changed program guide

information packet has only the information of the recorded program, the packet discrimination information is supplied from the program guide read circuit 420 to the selector 410 without designating the channel.

[0065]

Also in the reproduction or at replay, in accordance with the viewing right information packets VECM and AECM, the viewing permission judging circuit 440 judges whether the packet is reproduced, and performs a toll charging process if required. Therefore, the recorded tape cannot be reproduced freely, and the rights of copyright holders and service suppliers can be protected.

[0066]

Another embodiment of the decryption and decoding circuits of the embodiment shown in Fig. 5 is shown in Fig. 10. Some elements shown in Fig. 10 are shared by the embodiment shown in Fig. 9. The shared elements are represented by identical reference numerals, and the detailed description thereof is omitted. In Fig. 10, reference numeral 430 represents a time setting circuit, reference numeral 431 represents a comparator, and reference numeral 441 represents a viewing permission judging circuit.

[0067]

First, the case where a signal received by the tuner 210 is inputted, will be described. The signal corresponding to Fig. 8(2) is applied to the terminal 400.

The program information packet PG has the same packet discrimination information for all transmission channels. Therefore, in accordance with this packet discrimination information, the selector 410 selects the program guide information packet PG having the contents shown in Table 1, and supplies it to the program information read circuit 420 which supplies the time setting circuit 430 with the date and time when the program information packet PG was received. In accordance with the supplied date and time information, the time setting circuit 430 sets the current time. The program guide information shown in Table 1 is inputted to the program guide decoding circuit 421 to decode the program guide information and supply it to the selector 470. If the control signal from the control circuit is input from the terminal 404 and the program guide information is selected, the selector 470 outputs the decoded program guide information.

[0068]

Similar to the embodiment shown in Fig. 9, if the control signal for selecting a desired channel is input from the terminal 404, the program guide read circuit 420 supplies the packet discrimination information to the selector 410 which in turn supplies the video and audio packets to the video and audio expansion circuits 460 and 461, respectively. The bit compressed signals are expanded and inputted to the selector 470 which in accordance with the control signal supplied from the terminal 404, outputs

the bit compressed signals from the terminal 400.

[0069]

If a signal reproduced by VTR 53 is inputted, similar to the embodiment shown in Fig. 9, the changed program guide information packet MPG shown in Table 2 is inputted to the program guide information read circuit 420. Of this packet MPG, the date and time information is supplied to the comparator 431. The input date and time information is the information when the program was recorded in VTR 53. The current date and time are inputted from the time setting circuit 430 to the comparator 431 to compare the current date and time with those when the program was recorded. The viewing right information packets VECM and AECM of the reproduced program are supplied from the selector 410 to the viewing permission judging circuit 441 which judges whether the program has or has not a reproduction limit, and outputs the judgement result to the comparator 431. If the program has not a reproduction limit, the comparator 431 does not output the control signal restricting the signal expansion to the video and audio expansion circuits 460 and 461. If the program has a reproduction limit, this reproduction limit condition is notified to the comparator 431. The reproduction limit condition is, for example, to allow the reproduction only the day when the program was recorded, or for three days or seven days after the record. In accordance with this condition, the reproduction permission

is judged based upon a difference between the current date and time and the recorded date and time as obtained by the comparator 431. In accordance with this reproduction permission or inhibition, and in the case of the reproduction inhibition, a signal restricting the expansion is supplied to the video and audio expansion circuits 460 and 461. In this manner, the recorded tape cannot be reproduced freely and the rights of copyright holders and service suppliers can be protected.

[0070]

According to the present invention, even if the recorded tape is copied, only a tape of the same condition is formed. Therefore, even if a tape is copied without permission of copyright holders or service suppliers, images and sounds of the copied tape are restricted and a so-called pirate tape cannot be formed.

[0071]

Furthermore, since the current time is set in accordance with the received signal, the current time will not be changed or will not be shifted by subscribers. With the same reasons, the lapse time after the record can be correctly shown and cannot be changed by subscribers, so that the rights of copyright holders and service subscribers can be protected.

[0072]

[Effects of the Invention]

According to the present invention, input digital

information can be efficiently recorded, and restrictions of reproduction can be easily and reliably performed.

[Brief Description of Drawings]

[Fig. 1]

Fig. 1 is a block diagram showing a digital broadcast system and an analog broadcast system to which the invention is applied.

[Fig. 2]

Fig. 2 is a block diagram showing a program distribution center according to an embodiment of the invention.

[Fig. 3]

Fig. 3 is a block diagram showing a transmission processing device according to an embodiment of the invention.

[Fig. 4]

Fig. 4 is a block diagram showing a receiver decoder according to an embodiment of the invention.

[Fig. 5]

Fig. 5 is a block diagram showing a receiver decoder according to an embodiment of the invention.

[Fig. 6]

Fig. 6 is a block diagram showing a VTR according to an embodiment of the invention.

[Fig. 7]

Fig. 7 shows signal waveforms according to the

invention.

[Fig. 8]

Fig. 8 shows signal waveforms according to the invention.

[Fig. 9]

Fig. 9 is a block diagram showing an embodiment of the present invention.

[Fig. 10]

Fig. 10 is a block diagram showing an embodiment of the invention.

[Description of Reference Numerals]

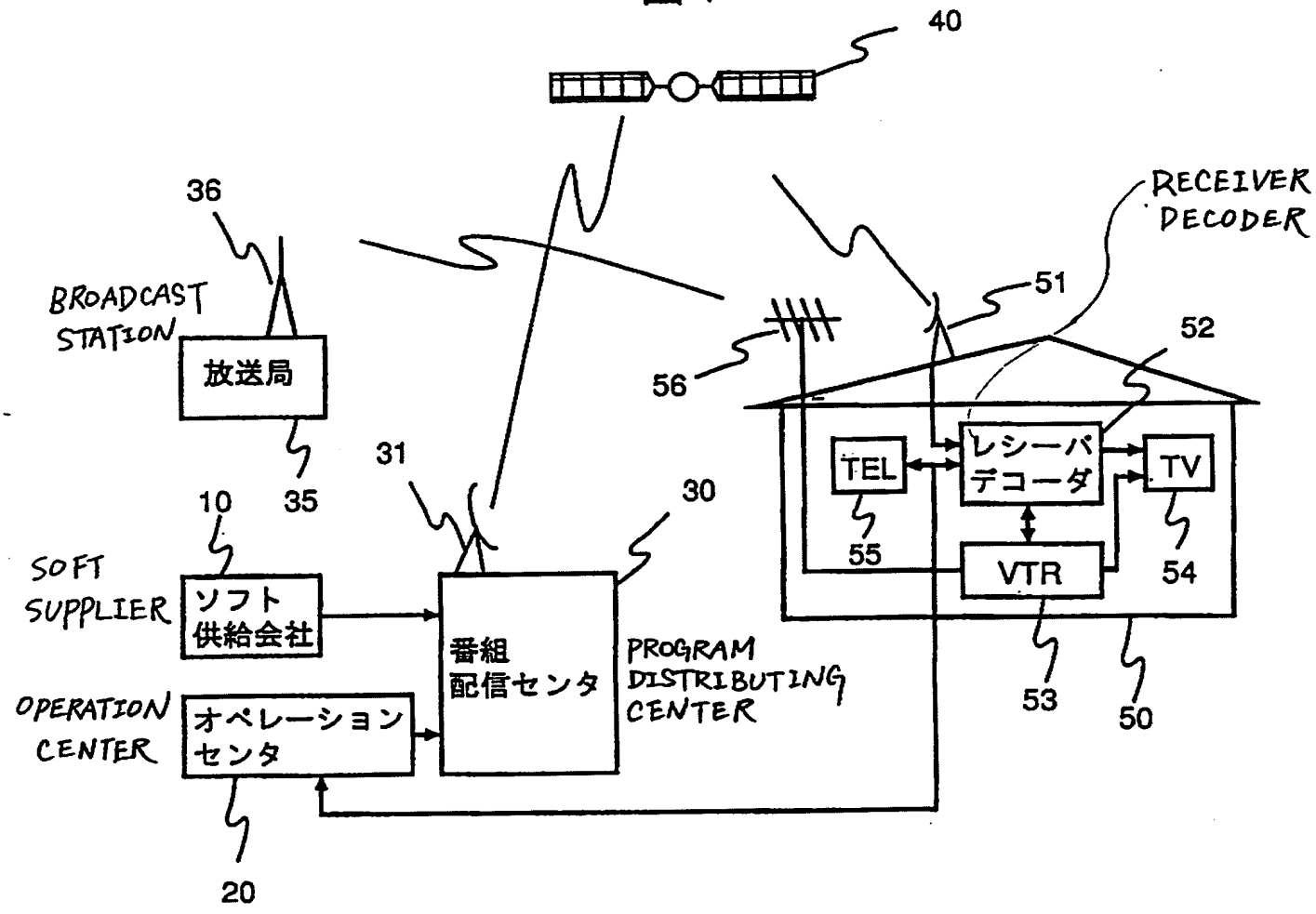
52... receiver decoder, 53... VTR, 171 to 173... bit compressor, 180... transmission processing device, 181 to 184... encryptor, 185... time-division multiplexer, 186... error correction code adder, 187... modulator, 220, 331... error correction circuit, 230... program dividing circuit, 260... decryption circuit, 260... decoding circuit, 311... parity adder circuit, 410, 470... selector, 420... program guide information read circuit, 430... time setting circuit, 431... comparator, 440, 441... viewing permission device.

〔TITLE OF DOCUMENT〕 DRAWINGS
【書類名】 図面

【図1】 〔FIG.1〕

FIG.1

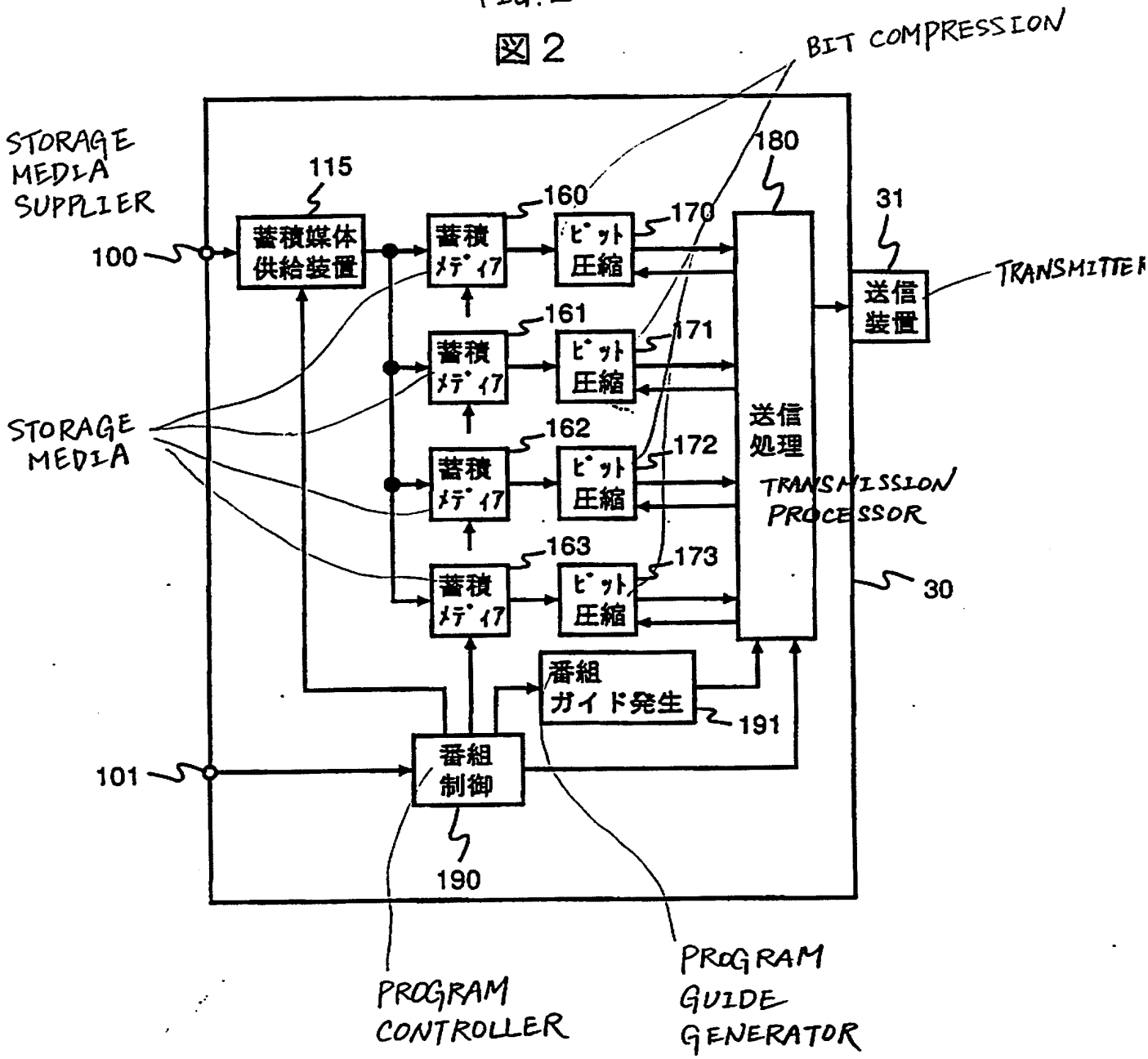
図1



【図２】〔FIG.2〕

FIG.2

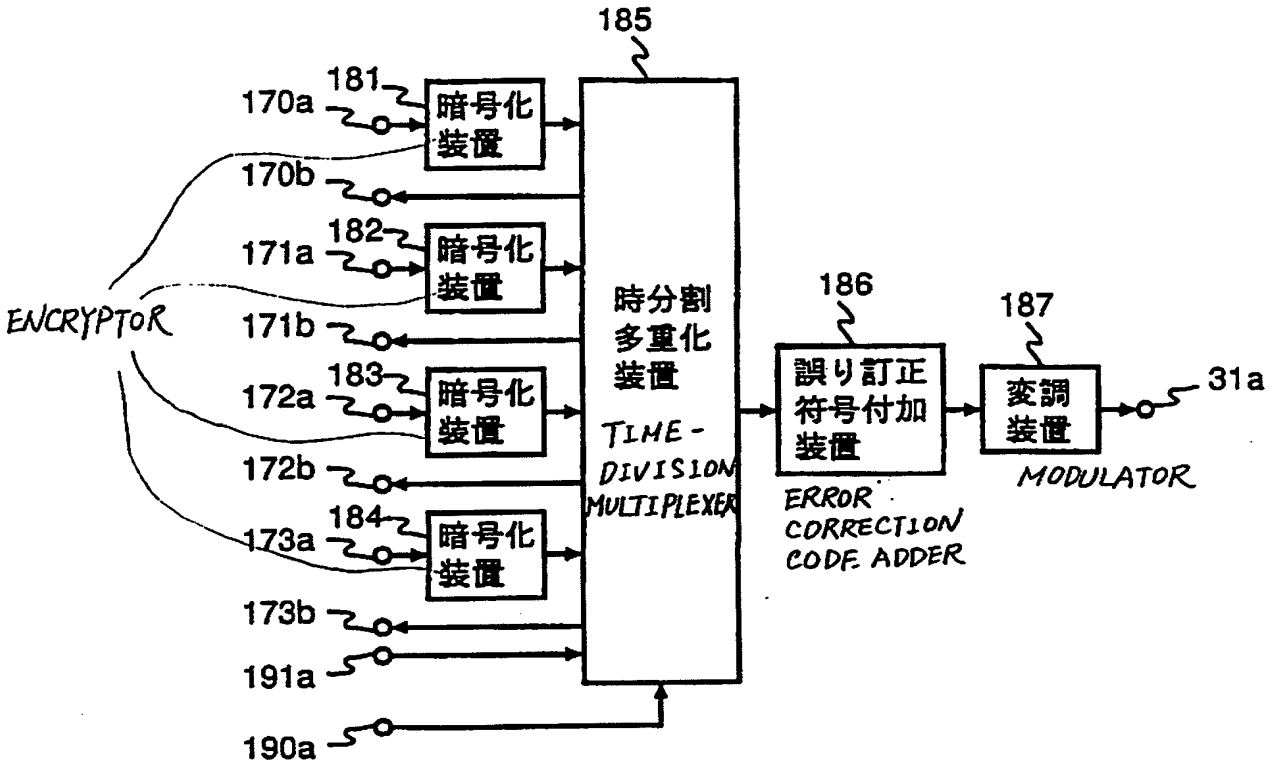
図２



【図3】【FIG. 3】

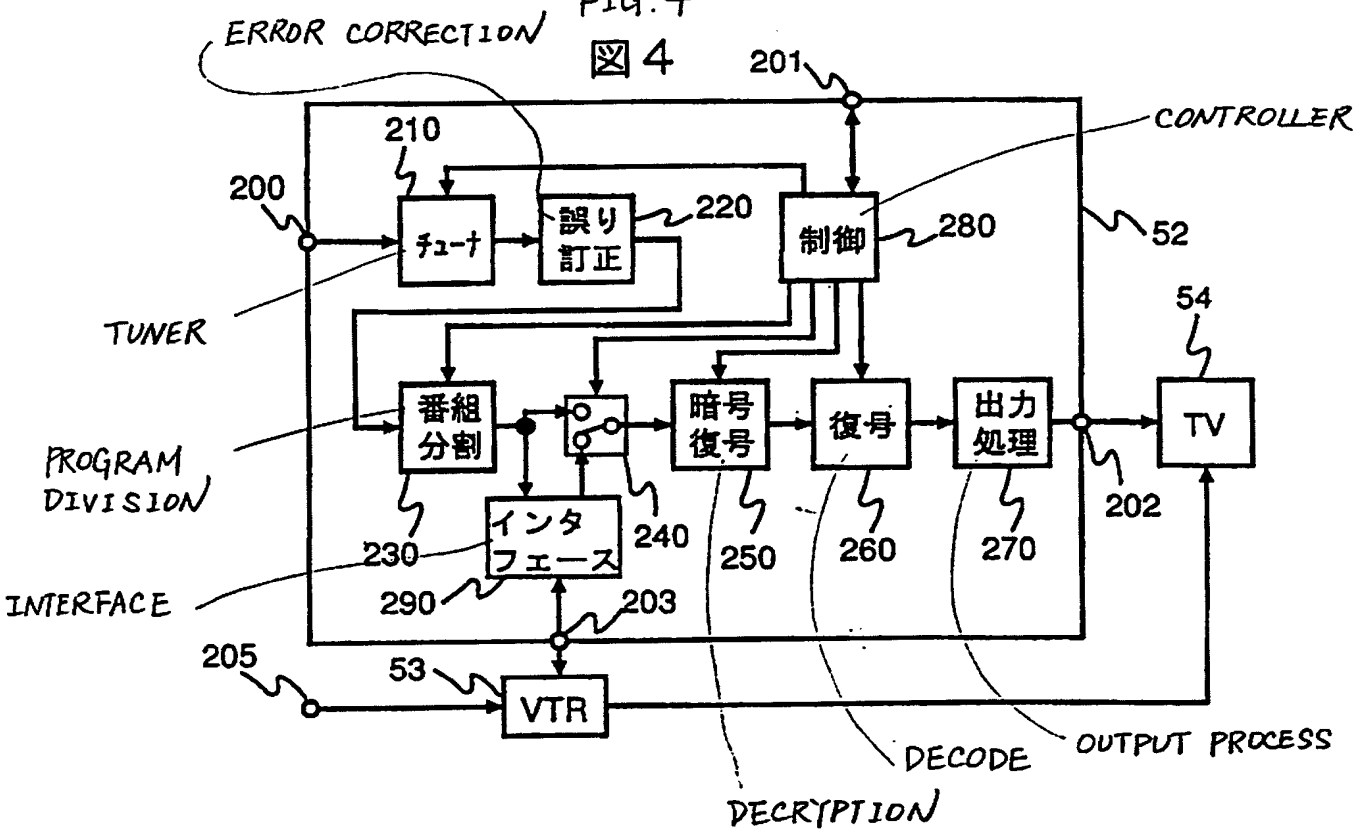
FIG. 3

図3



【図4】〔FIG.4〕

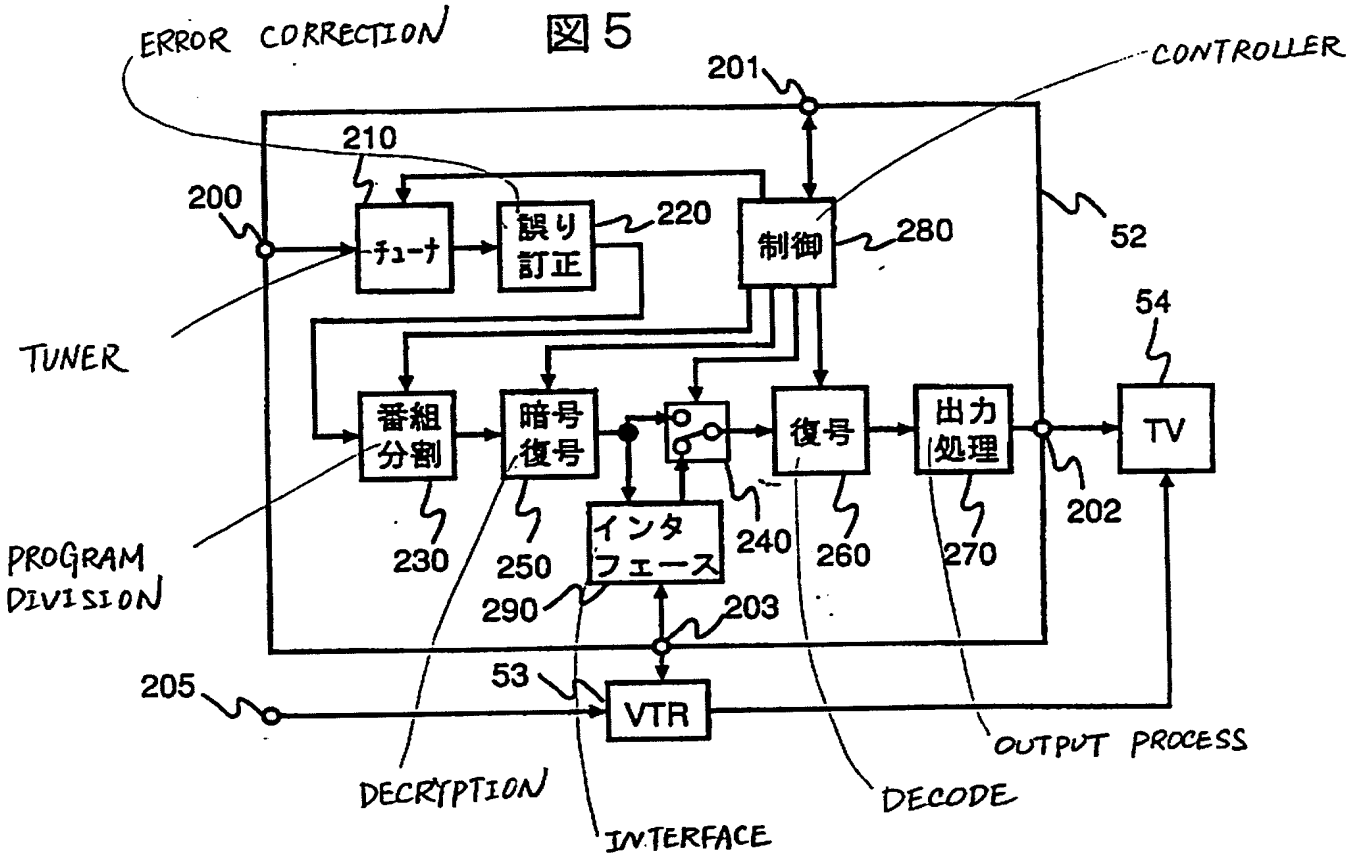
FIG.4
図4



【図５】〔FIG.5〕

FIG.5

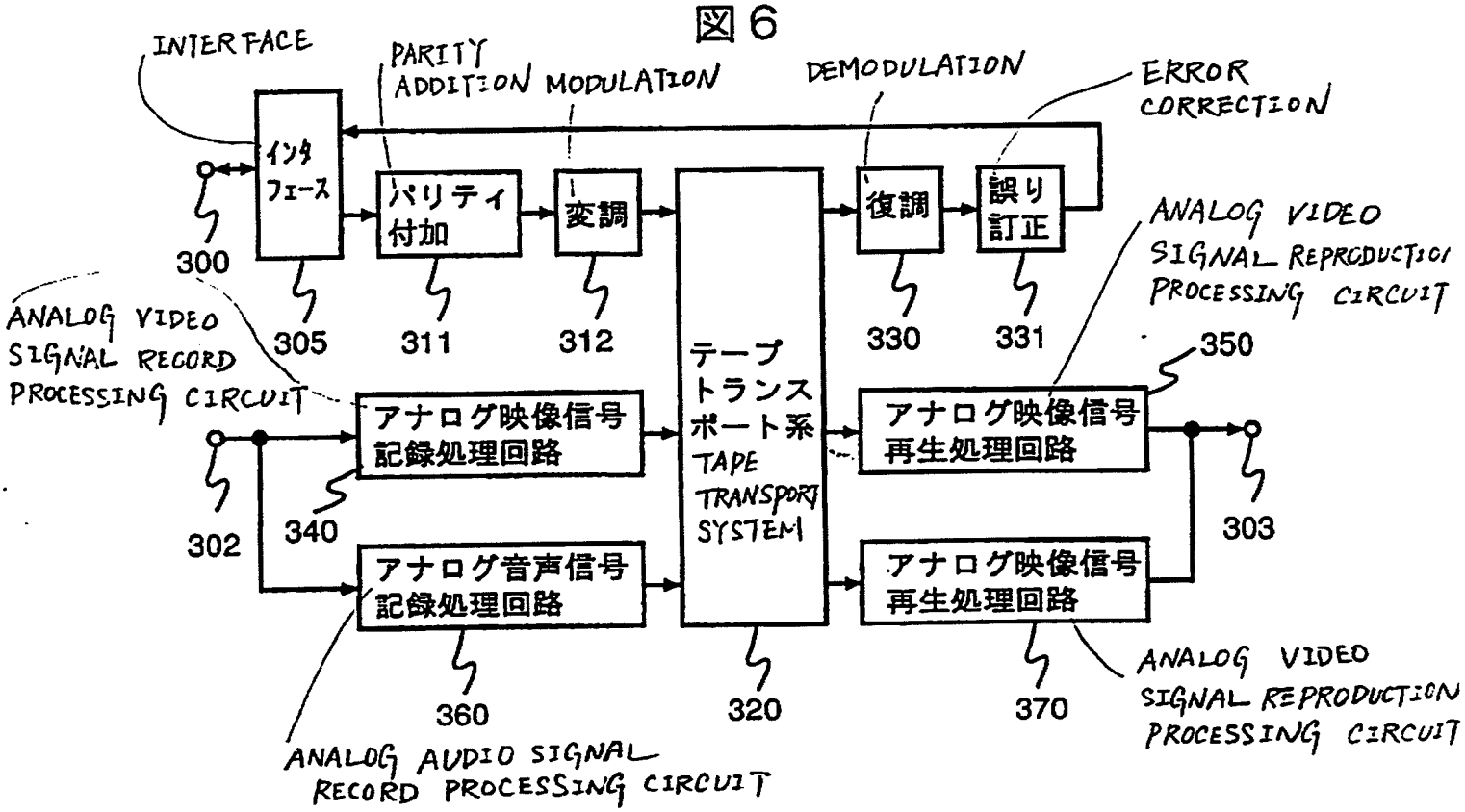
図５



【図6】〔FIG. 6〕

FIG. 6

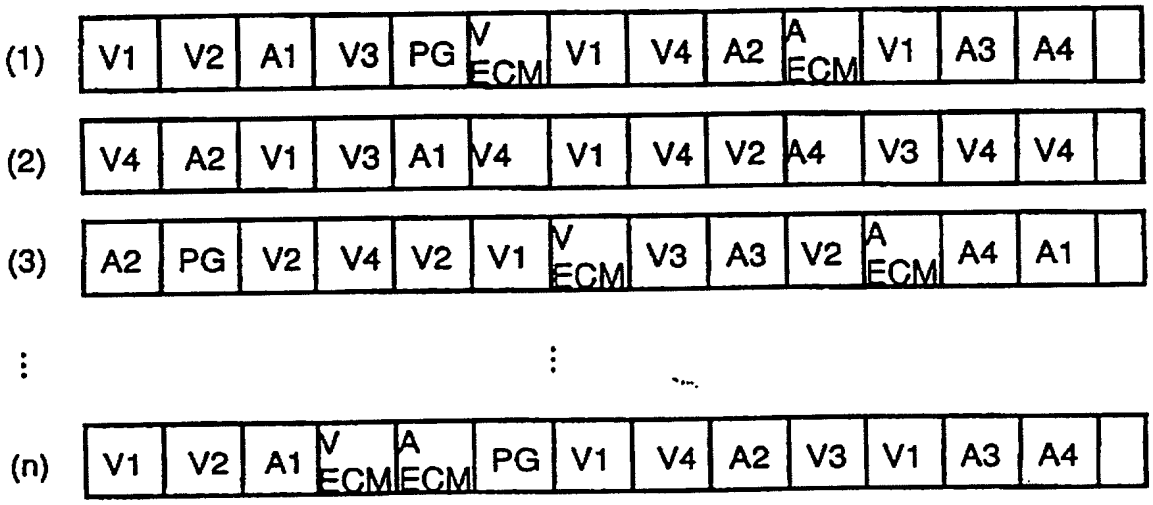
図6



【図7】〔FIG. 7〕

FIG. 7

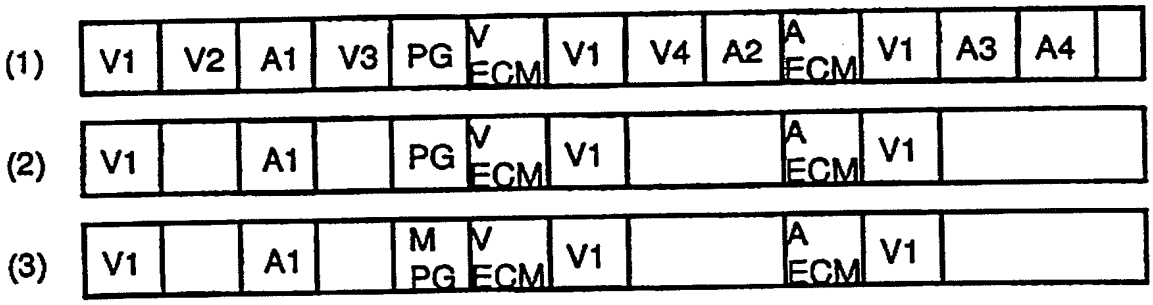
図7



【図8】〔FIG.8〕

FIG. 8

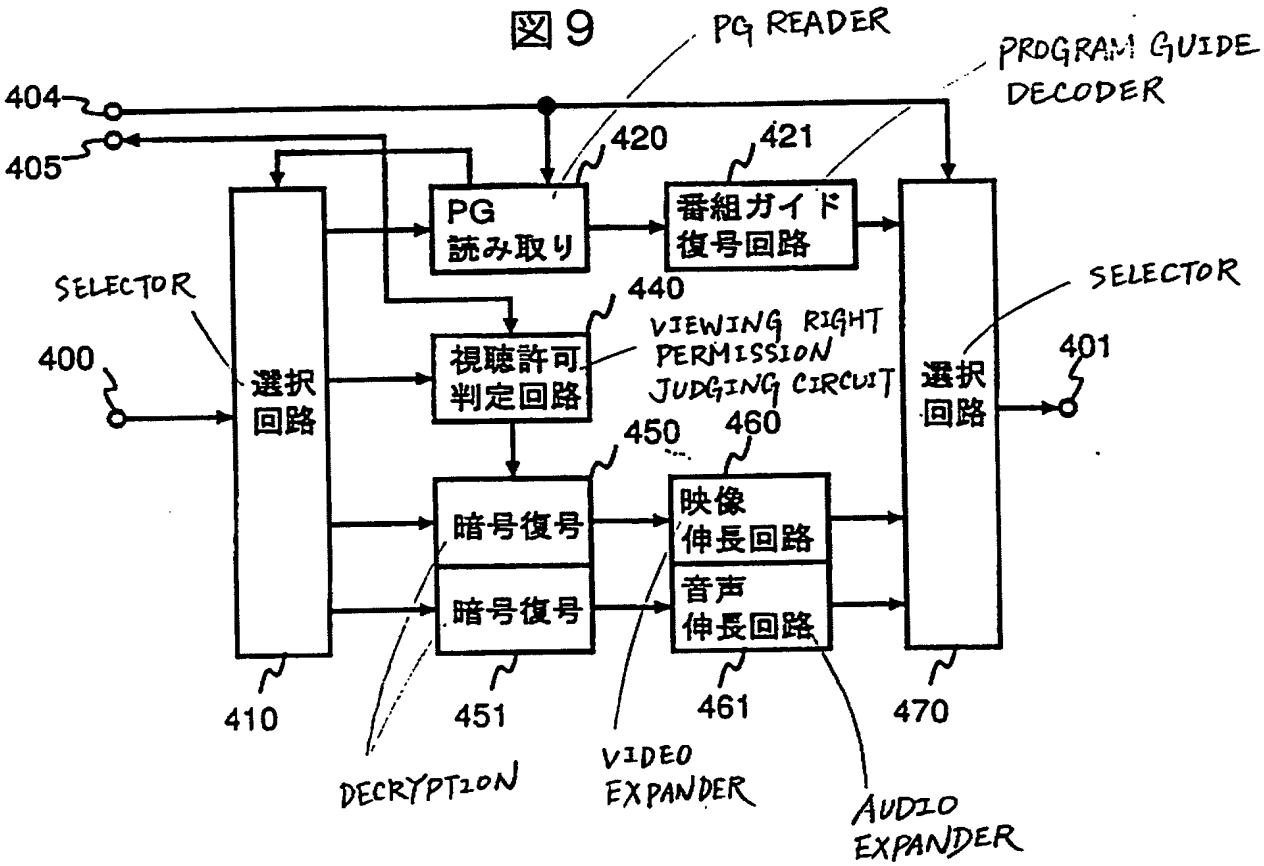
図8



【図9】〔FIG.9〕

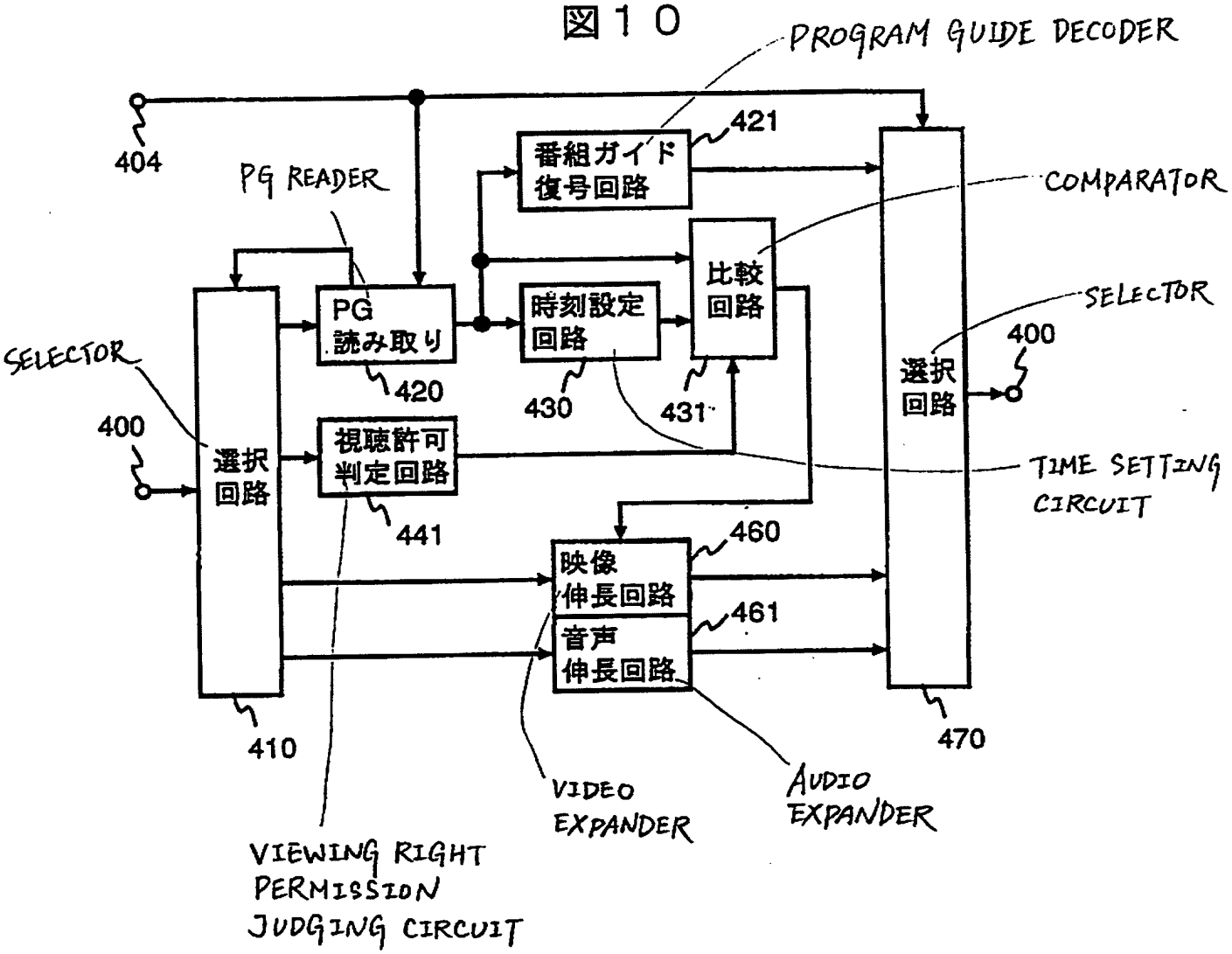
FIG. 9

図9



【図１０】〔FIG. 10〕

FIG. 10
図１０



[Title of Document] Abstract

[Object]

Digitally compressed information is recorded, and a reproduction of the recorded information is constrained.

[Structure]

Encrypted signals, viewing right information, and guide information of recorded programs are recorded to incur a charge at each reproduction. Alternatively, decrypted signals, viewing right information, and guide information of recorded programs are recorded to permit a reproduction for a predetermined time duration in accordance with the viewing right information.

[Effect]

Reproduction can be easily and reliably constrained so that unlimited copies can be prevented and the rights of copyright holders and service subscribers can be protected.

[Selected Drawing] Fig. 10